SONGS Seismic Research Projects

Energy Division

Independent Peer Review Group

February 25, 2013

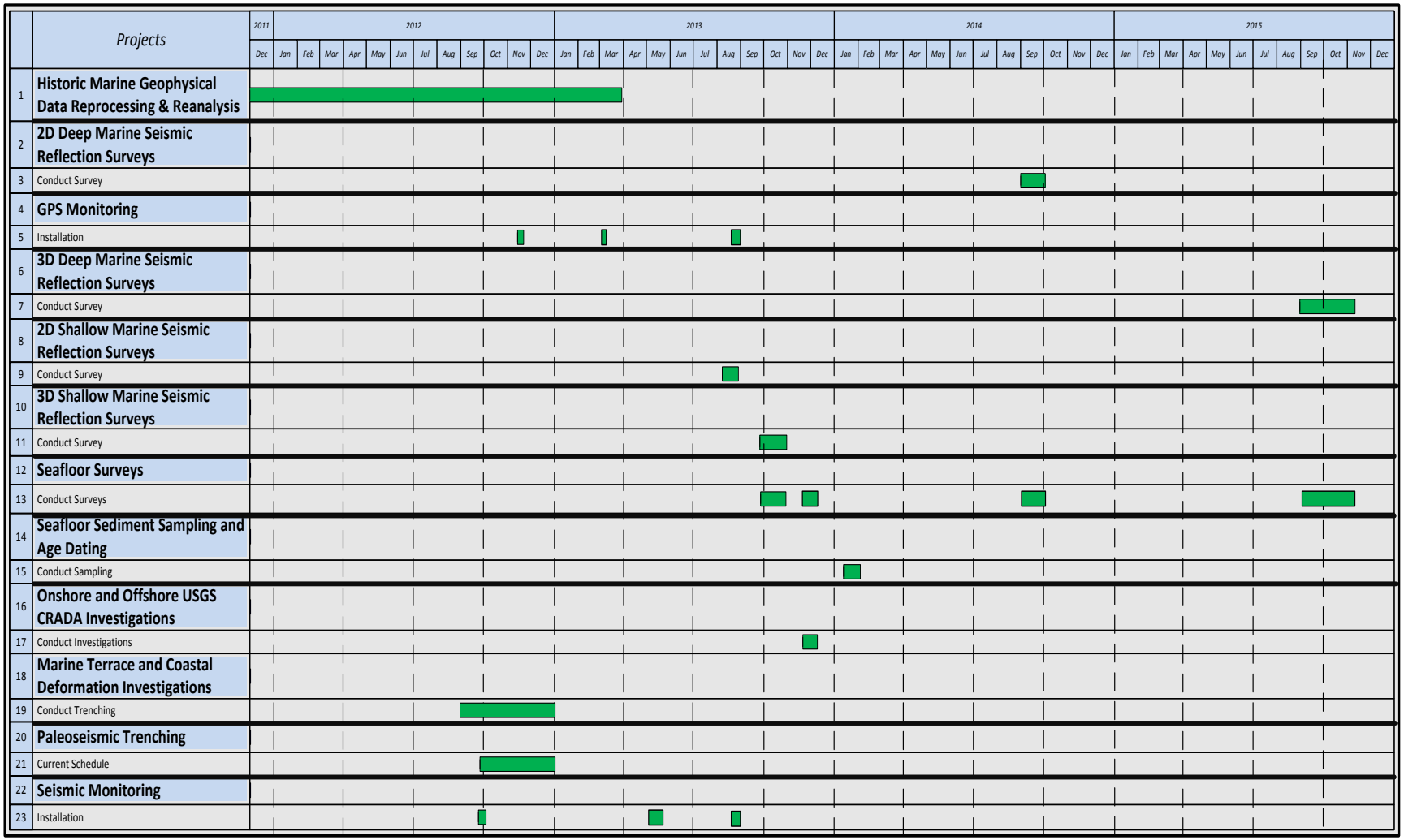
Agenda

- Background
- Schedule
- Project Update

Background

- The California Energy Commission recommended
  - Investigations of the seismic setting around SONGS for use in understanding long-term seismic vulnerability of the plant
  - Use of three-dimensional seismic reflection mapping, other techniques, and a permanent GPS array for resolving seismic uncertainties for SONGS
- The projects are designed to capture relevant seismic source data for:
  - Newport-Inglewood/Rose Canyon (NI/RC) Fault
  - Oceanside Blind Thrust (OBT) Fault
- Data examples: fault locations, geometries, types, slip rates, recurrence intervals
- Core Team
  - Mark Malzahn, SCE
  - Caroline McAndrews, SCE
  - Dr. Neal Driscoll, Scripps Institution of Oceanography
  - Dr. Graham Kent, University of Nevada, Reno

Schedule


Projects
2011
2012
2013
2014
2015
Dec
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
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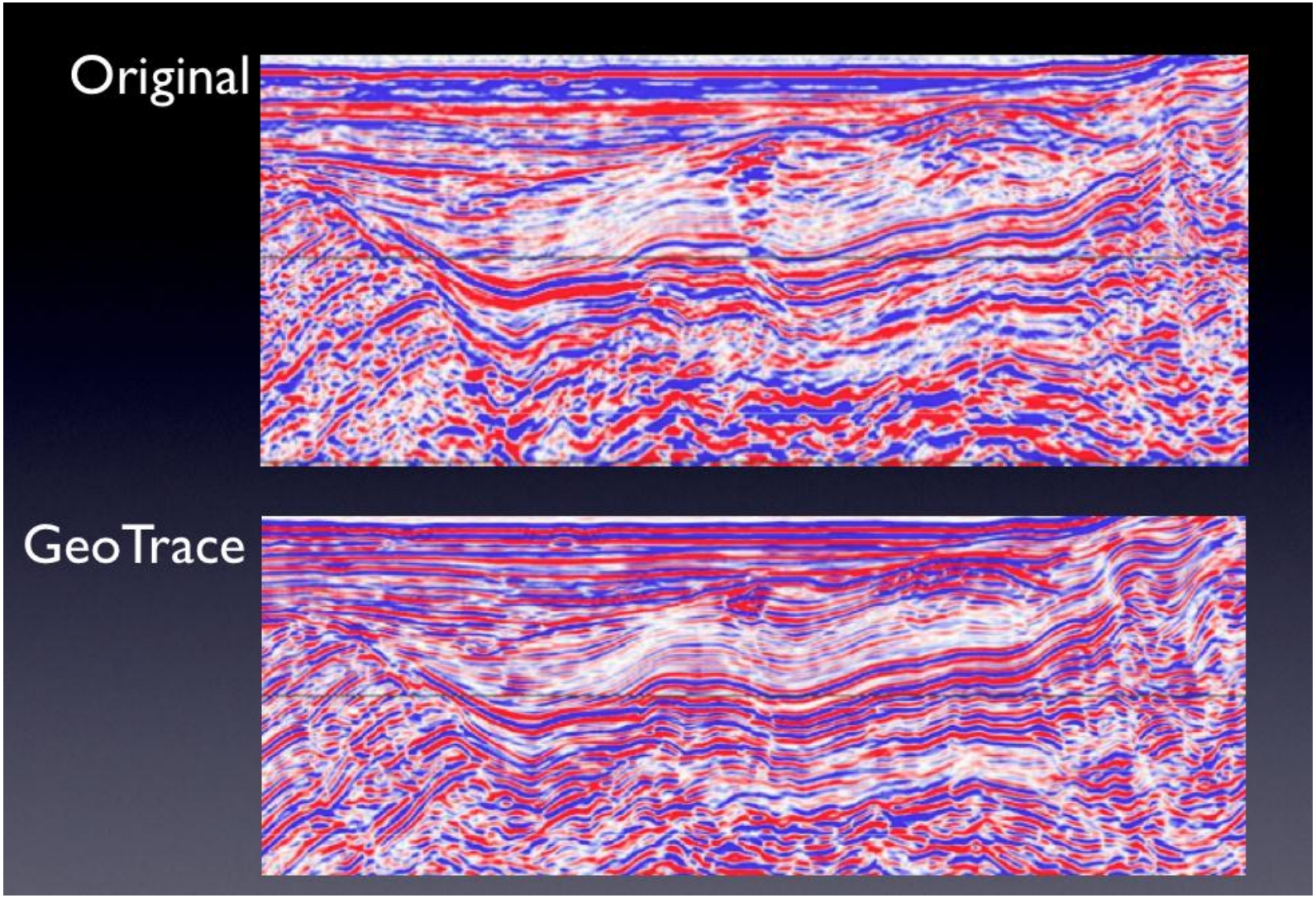
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1 Historic Marine Geophysical Data Reprocessing & Reanalysis
2 2D Deep Marine Seismic Reflection Surveys
3 Conduct Survey
4 GPS Monitoring
5 Installation
6 3D Deep Marine Seismic Reflection Surveys
7 Conduct Survey
8 2D Shallow Marine Seismic Reflection Surveys
9 Conduct Survey
10 3D Shallow Marine Seismic Reflection Surveys
11 Conduct Survey
12 Seafloor Surveys
13 Conduct Surveys
14 Seafloor Sediment Sampling and Age Dating
15 Conduct Sampling
16 Onshore and Offshore USGS CRADA Investigations
17 Conduct Investigations
18 Marine Terrace and Coastal Deformation Investigations
19 Conduct Trenching
20 Paleoseismic Trenching
21 Current Schedule
22 Seismic Monitoring
23 Installation

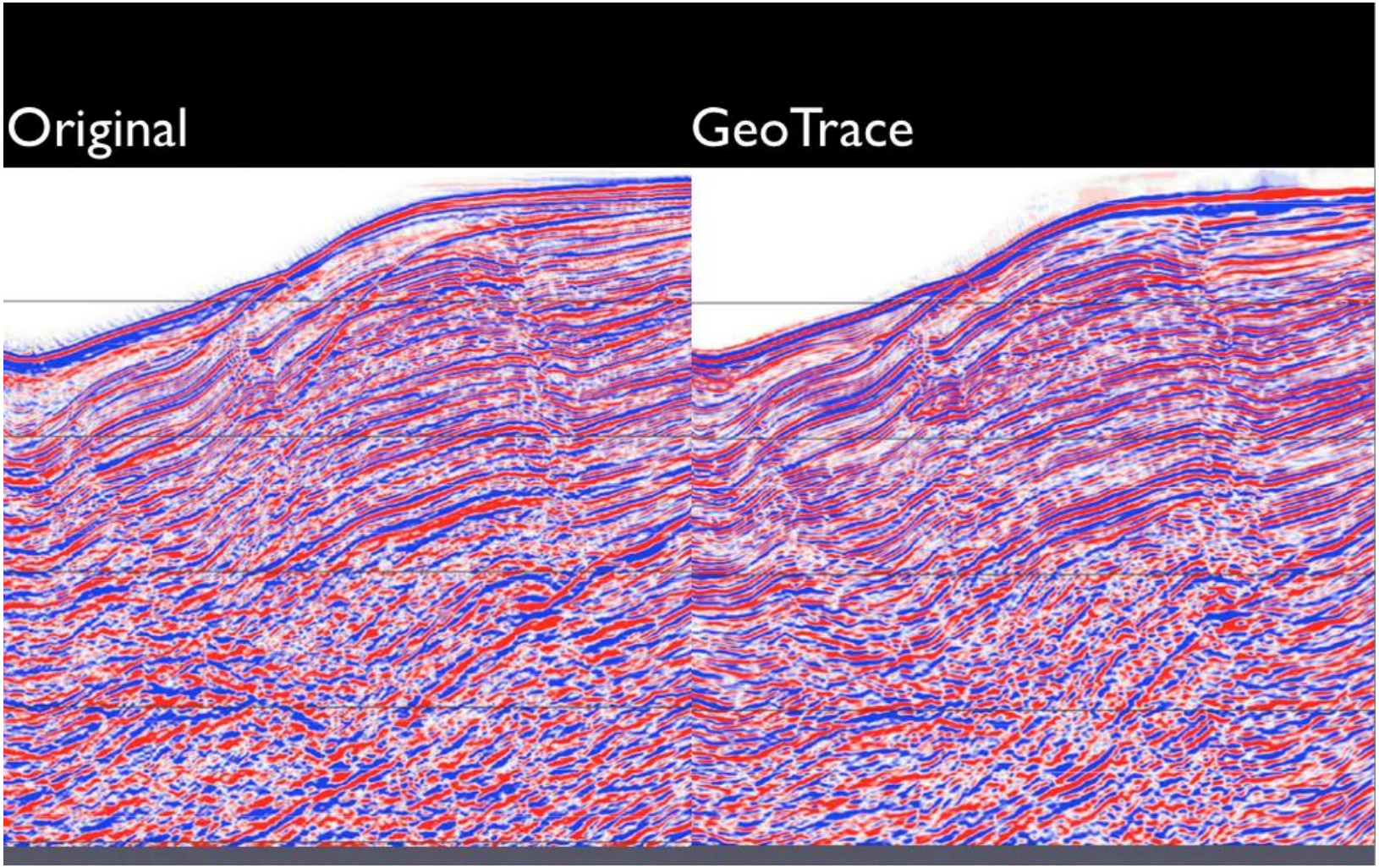
Project: Historical Marine Geophysical Data Reprocessing and Reanalysis

- Scope:
  - Reanalyze and reprocess existing seismic reflection data collected by SCE, USGS, petroleum industry, and academia
- Status:
  - 72 seismic data sets were examined in the study region of which 7 MultiChannel Seismic (MCS) datasets were digitally uploaded (approximately 220 seismic lines) and were analyzed for information about intersection between the OBT and the NI/RC faults
  - Only Chevron 1979 MCS dataset had correct format to support reprocessing
  - Reprocessing of Chevron 1979 MCS data yielding good results; 25 lines remain to be fully reprocessed – forecast complete by April 2013
  - 15 additional lines are being evaluated to determine their potential value

Project: Historical Marine Geophysical Data Reprocessing and Reanalysis



Project: Historical Marine Geophysical Data Reprocessing and Reanalysis



Project: 2/3D Deep Marine Seismic Reflection Survey

- Scope:
  - Collect and process 2/3D deep marine multi-channel seismic and geophysical data across the NI/RC and OBT faults
- Status:
  - Due to delays in permitting, 2D deep survey was not completed in 2012
  - The applications to conduct work were withdrawn and will be re-submitted once a survey date can be set
    - Need to align survey resources (e.g., ship, permits, etc.)
    - Need to address potential permit technical questions
  - 3D Deep Marine Seismic Reflection Survey will follow 2D Deep Survey if warranted

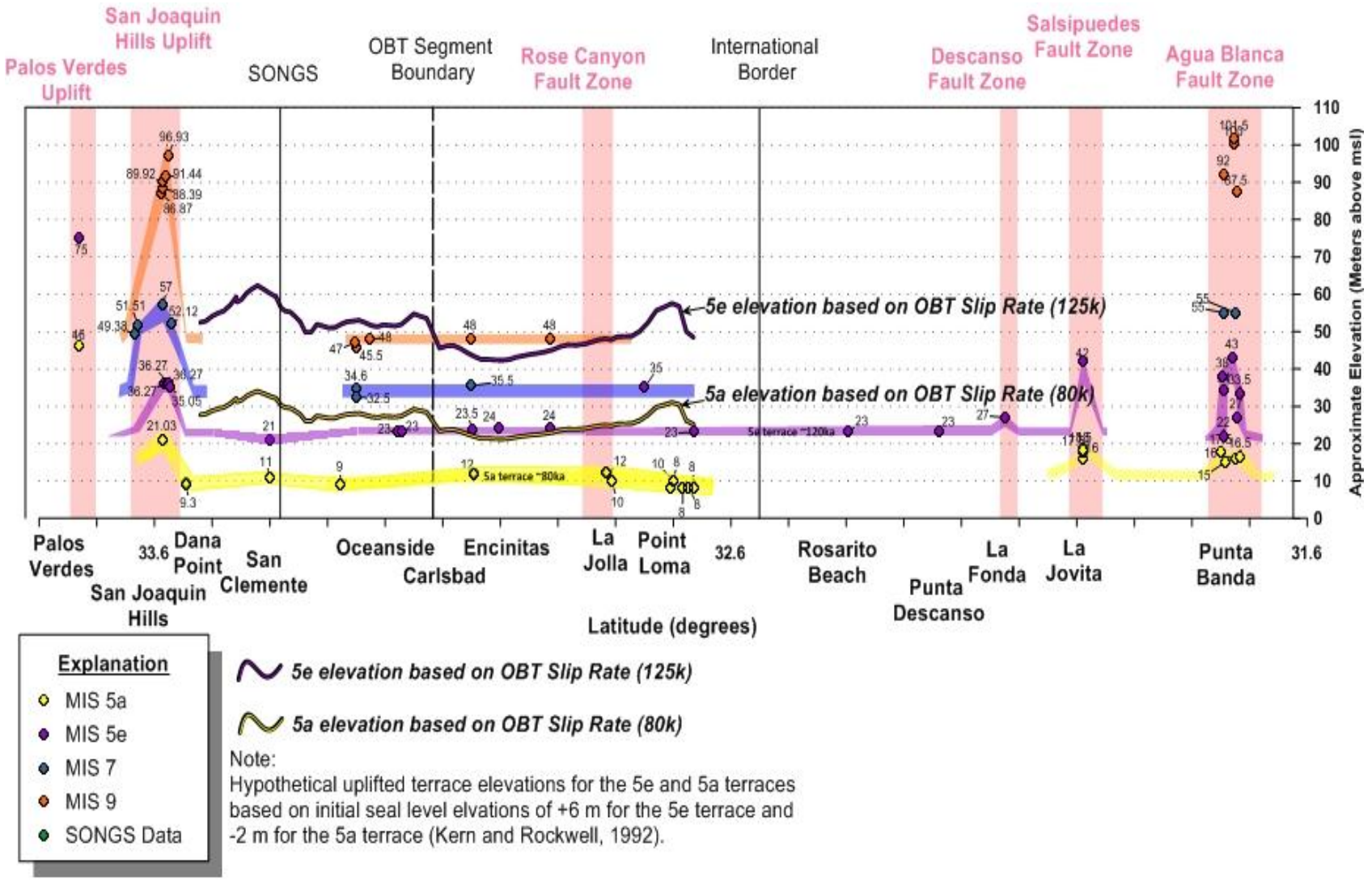
Project: Paleoseismic Trenching

- Scope:
  - Excavate trenches across the RC segment of the NI/RC Fault in San Diego county to measure fault displacement and establish fault history directly from the fault zone
- Status:
  - Trenching report issued in January 2013
  - 2 most recent events (600 AD and 750 AD) on Rose Canyon fault appear to be older than previously thought (1450 AD)
  - Event magnitudes may be lower, with shorter recurrence intervals than previously thought

Project: Marine Terrace and Coastal Deformation Investigations

- Scope:
  - Collect data related to vertical displacement along the southern Orange County and northern San Diego county coastline for use in assessing vertical deformation
- Status:
  - Terrace mapping was performed at Camp Pendleton, San Clemente State Beach, and Crystal Cove State Park
  - Preliminary results indicate regional uplift from Baja California to north of SONGS
  - Regional uplift rates are not consistent with the proposed location and segmentation of the Oceanside Blind Thrust
  - Final report to be issued pending completion of radioisotope age-dating

Project: Marine Terrace and Coastal Deformation Investigations



Note:
Hypothetical uplifted terrace elevations for the 5e and 5a terraces based on initial seal level elvations of +6 m for the 5e terrace and -2 m for the 5a terrace (Kern and Rockwell, 1992).

Project: GPS Monitoring

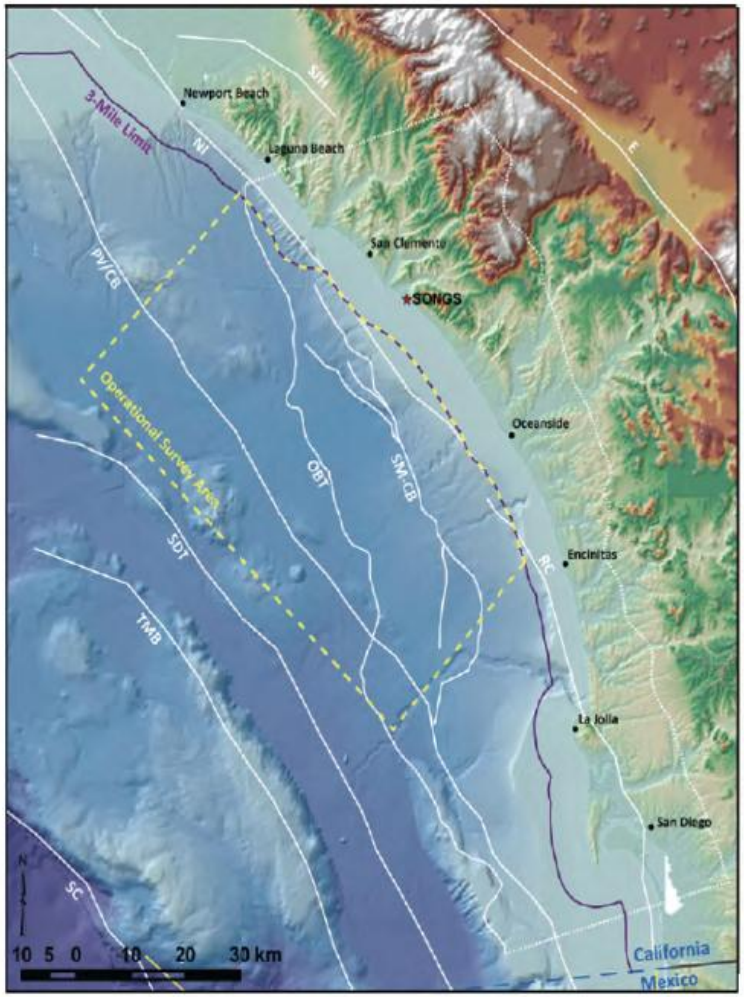
- Scope:
  - Install and monitor continuous GPS stations in the region surrounding SONGS to observe crustal deformation patterns and regional strain accumulation
- Status:
  - Current total of 7 newly-installed stations – most recently at Rancho Mission Viejo & SONGS
  - Offshore installation scheduled for 2/27
  - Establishing permitting for 3 locations at Camp Pendleton (USMC) and 1 location in Laguna Beach – all 4 locations expected to be installed in 2013

Project: GPS Monitoring

Yellow: Installed Blue: Camp Pendleton
Red: Laguna Beach Purple: Platform Elly

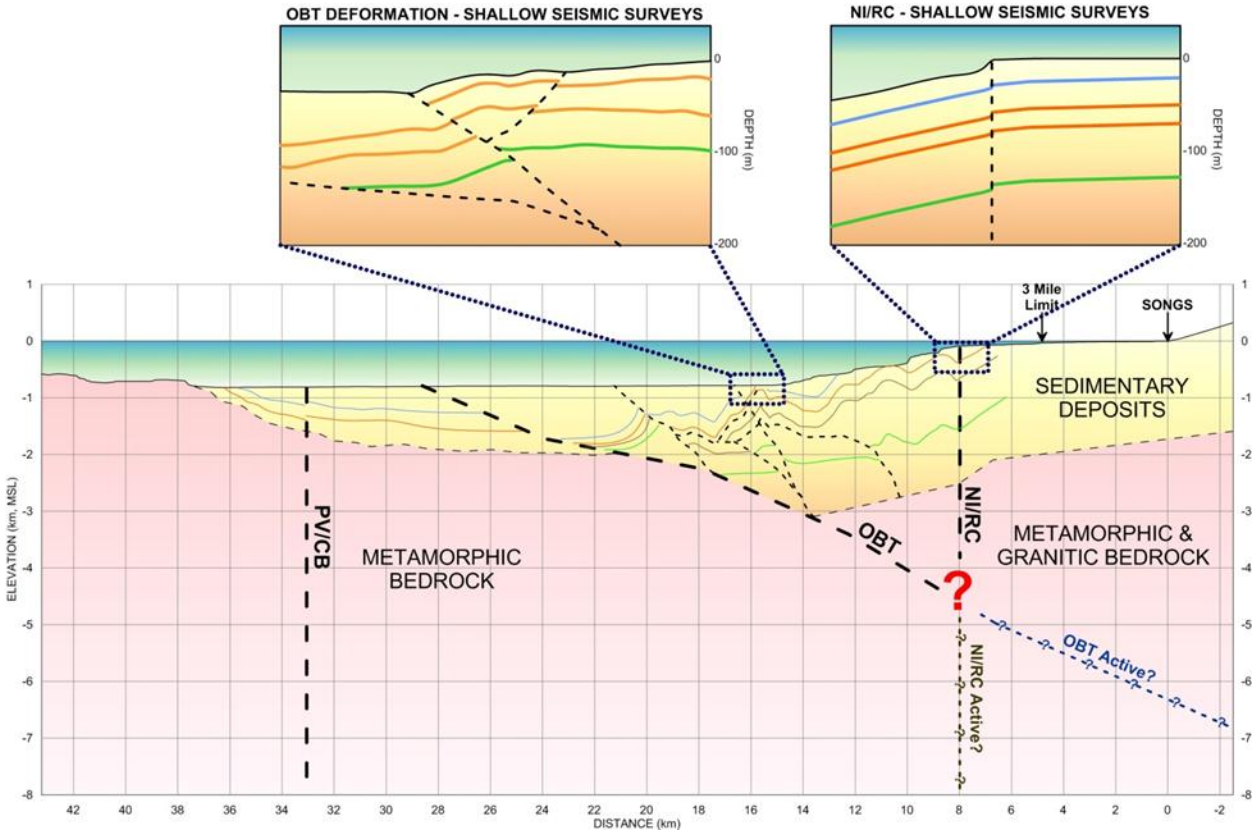
Project: 2/3D Shallow Marine Seismic Reflection Survey

- Scope:
  - Collect and process 2D shallow marine seismic reflection data to image the geometry of the NI/RC Fault and shallow deformational features associated with the OBT
- Status:
  - 2D work is scheduled for August 2013
  - 3D work will follow the 2D Shallow Survey and will start in October 2013



Project: 2D Shallow Marine Seismic Reflection Survey

- Schematic of shallow seismic imaging and generalized profile of offshore geologic structure



Project: Seafloor Surveys

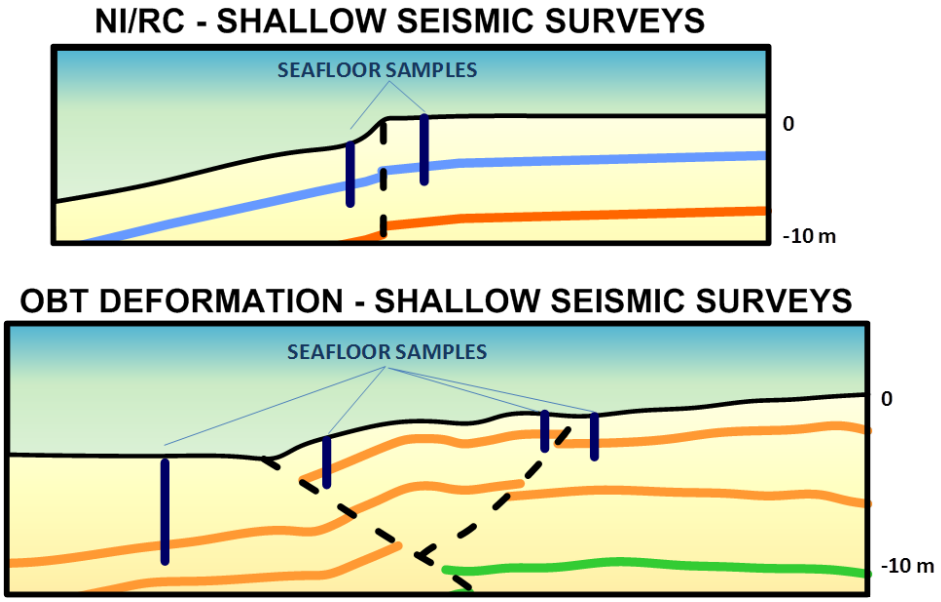
- Scope:
  - Collect and process bathymetry, gravity, and magnetic data to image the geometry of the NI/RC and OBT faults
- Status:
  - Work to be performed concurrently with shallow and deep marine seismic reflection surveys
    - First data to be collected in August of 2013

Project: USGS Southern California Collaborative Seafloor Surveys (SCCSS)

- Scope:
  - Collection, processing, and interpretation of shallow high-resolution sparker MultiChannel Seismic (MCS) data along the outer shelf and slope offshore of southern Orange County and northern San Diego Counties
  - Focused surveys will be used to support planning for sediment sampling
- Status:
  - Work scheduled to begin November 2013

Project: Seafloor Sediment Sampling and Age Dating

- Scope:
  - Collect organic and sediment samples using gravity, piston, and vibracores to aide in determining the history of the NI/RC and OBT faults
- Status:
  - Work scheduled to begin January 2014
    - Locations to be determined by shallow marine seismic surveys



Project: Seismic Monitoring

- Scope:
  - Install and maintain permanent onshore seismographs near SONGS and install and maintain temporary ocean bottom seismometers (OBS) offshore for a three year period
- Status:
  - Single Station Sigma monitor was installed at SONGS October 5, 2013 with USGS providing monitoring
  - Broadband OBS campaign (temporary) installation starting May 2013
  - Onshore seismographs installation pending permit/license issuance

Project: Seismic Monitoring

Other Projects:

- NRC Required SSHAC
  - Scope: Implement a SSHAC Level 3 consistent with NRC requirements
  - Status:
    - Source Characterization and Ground Motion Workshop #1 will be completed in the first quarter 2013
    - Summary documents will be issued following each meeting
    - IPRG members are observing
- Site Characterization
  - Scope: Develop base case, one-dimensional subsurface profile and dynamic material properties for use in the site response analyses
  - Status:
    - Draft report was reviewed by Dr. Bob Kennedy (RPK Consulting), Dr. Ken Stokoe, (Professor UT-Austin) , Dr. Jon Stewart (Professor UCLA) and Dr. Mladen Vucetic (Professor UCLA).
    - Final report is expected to be issued mid-March 2013

Questions?